

CLAIMS

1. A method for adapting a filter length of an echo canceller filter based on data rate, the method comprising the steps of:

measuring a plurality of approximate filter lengths at a plurality of data rates;

5 fitting a polynomial to a curve representing the approximate filter lengths at the plurality of data rates;

inputting a selected data rate to a function of the polynomial for generating an approximate number of filter taps for modeling an echo channel for the selected data rate; and

10 adjusting the number of filter taps based on the selected data rate;

wherein a mean square error associated with the echo canceller filter is reduced.

2. The method of claim 1, wherein a number of CPU cycles per filter coefficient update is reduced.

3. The method of claim 1, wherein a number of echo canceller coefficient

15 updates is increased by a reduction in CPU cycles.

4. The method of claim 1, wherein the step of adjusting is a static adjustment.

5. The method of claim 1, wherein the step of adjusting is prior to an echo canceller training session.

20 6. The method of claim 1, wherein the curve is a linear curve.

7. The method of claim 1, wherein training time of the echo canceller filter at lower rates is extended.

8. The method of claim 1, wherein the filter length comprises a number of filter taps for modeling an echo channel.

25 9. The method of claim 1, further comprising the step of:

determining an echo tail wherein the echo tail comprises a point where at least one filter coefficient decays to a value below a predetermined value towards an end of a filter.

10. The method of claim 9, further comprising the step of:

30 varying the number of filter taps for compensating for the echo tail.

11. The method of claim 9, wherein the value is approximately equal to one least significant bit.
12. The method of claim 9, wherein the at least one filter coefficient approaches a noise floor.
- 5      13. The method of claim 1, further comprising the step of:  
detecting an analog delay, wherein the analog delay is a delay in time of an echo.
14. The method of claim 13, further comprising the step of:  
determining a section of filter taps towards a beginning of a filter, the section of filter taps approaching a quantization noise floor.
- 10     15. The method of claim 13, further comprising the step of:  
varying the number of filter taps for compensating for the analog delay.
16. The method of claim 1, wherein the modem operates according to the G.SHDSL standard.
17. In a communication network having a first modem in communication with  
15 a second modem over a communication channel, a system for adapting a filter length of an echo canceller filter based on data rate, the system comprising:  
a measuring module for measuring a plurality of approximate filter lengths at a plurality of data rates;
- 20     a fitting module for fitting a polynomial to a curve representing the approximate filter lengths at the plurality of data rates;
- an input module for inputting a selected data rate to a function of the polynomial for generating an approximate number of filter taps for modeling an echo channel for the selected data rate; and
- 25     an adjusting module for adjusting the number of filter taps based on the selected data rate;  
wherein a mean square error associated with the echo canceller filter is reduced.
18. The system of claim 17, wherein a number of CPU cycles per filter coefficient update is reduced.
19. The system of claim 17, wherein a number of echo canceller coefficient  
30     updates is increased by a reduction in CPU cycles.

20. The system of claim 17, wherein the adjusting module performs static adjustment.

21. The system of claim 17, wherein the adjusting module performs an adjustment prior to an echo canceller training session.

5 22. The system of claim 17, wherein the curve is a linear curve.

23. The system of claim 17, wherein training time of the echo canceller filter at lower rates is extended.

24. The system of claim 17, wherein the filter length comprises a number of filter taps for modeling an echo channel.

10 25. The system of claim 17, further:

an echo tail determining module for determining an echo tail wherein the echo tail comprises a point where at least one filter coefficient decays to a value below a predetermined value towards an end of a filter.

26. The system of claim 25, further comprising:

15 a varying module for varying the number of filter taps for compensating for the echo tail.

27. The system of claim 25, wherein the value is approximately equal to one least significant bit.

28. The system of claim 25, wherein the at least one filter coefficient 20 approaches a noise floor.

29. The system of claim 17, further comprising:

a detecting module for detecting an analog delay, wherein the analog delay is a delay in time of an echo.

30. The system of claim 29, further comprising:

25 a filter tap determining module for determining a section of filter taps towards a beginning of a filter, the section of filter taps approaching a quantization noise floor.

31. The system of claim 29, further comprising:

a varying module for varying the number of filter taps for compensating for the analog delay.

32. The system of claim 17, wherein the modem operates according to the G.SHDSL standard.

33. A method for adapting a filter length of an echo canceller filter based on data rate, the method comprising the steps of:

5 initiating a line probe session;

performing an abbreviated echo canceller training during the line probe session for determining a length of an echo tail;

estimating a number of taps for the echo canceller filter based on the abbreviated echo canceller training; and

10 adjusting the number of taps;

wherein a mean square error associated with the echo canceller filter is reduced.

34. The method of claim 33, wherein the step of adjusting the number of taps further comprises the step of:

calculating a mean filter wherein

15

$$y_k = \frac{1}{10} \sum_{i=0}^9 w_{k-i} \quad k = 0, 1 \dots M - 1$$

where M represents a maximum length in taps of the echo canceller filter and w represents filter coefficients,

determining whether  $y_k$  drops below a predetermined threshold, and

20 truncating the echo canceller filter by discarding one or more remaining taps below the predetermined threshold.

35. The method of claim 34, wherein the predetermined threshold is determined by

25  $20 \log_{10} \left( \frac{T}{2^{15}} \right) = -80$

where  $T = 2^{15} 10^{\frac{-80}{20}} = 3.2768$ .

36. In a communication network having a first modem in communication with a second modem over a communication channel, a system for adapting a filter length of an echo canceller filter based on data rate, the system comprising:

- a line probe module for initiating a line probe session;
- 5 a training module for performing an abbreviated echo canceller training during the line probe session for determining a length of an echo tail;
- an estimating module for estimating a number of taps for the echo canceller filter based on the abbreviated echo canceller training; and
- 10 an adjusting module for adjusting the number of taps;

wherein a mean square error associated with the echo canceller filter is reduced.

37. The system of claim 36, wherein the adjusting module further comprises:

a calculating module for calculating a mean filter wherein

$$y_k = \frac{1}{10} \sum_{i=0}^9 w_{k-i} \quad k = 0, 1 \dots M - 1$$

15 where M represents a maximum length in taps of the echo canceller filter and w represents filter coefficients,

a determining module for determining whether  $y_k$  drops below a predetermined threshold, and

20 a truncating module for truncating the echo canceller filter by discarding one or more remaining taps below the predetermined threshold.

38. The system of claim 36, wherein the predetermined threshold is determined by

$$20\log_{10}\left(\frac{T}{2^{15}}\right) = -80$$

25 where  $T = 2^{15}10^{-\frac{80}{20}} = 3.2768$ .